

Direct Wafer Polishing with 5 nm Diamond

James C. Sung^{*,1,2,3}, Ming-Fong Tai⁴

Address: KINIK Company, 64, Chung-San Rd., Ying-Kuo, Taipei Hsien 239, Taiwan, R.O.C.

Tel: 886-2-2677-5490 ext.1150

Fax: 886-2-8677-2171

e-mail: sung@kinik.com.tw

¹ KINIK Company, 64, Chung-San Rd., Ying-Kuo, Taipei Hsien 239, Taiwan, R.O.C.

² National Taiwan University, Taipei 106, Taiwan, R.O.C.

³ National Taipei University of Technology, Taipei 106, Taiwan, R.O.C.

⁴ Department of Electronic Engineering, Wufeng Institute of Technology, Chia-yi 621, Taiwan, R.O.C.

Key Words: Nanom Diamond, CMP, ULSI, Wafer Polishing, Moore's Law

Abstract

CMP for making future semiconductor chips with nanom (nano meter) feature sizes can be accomplished by using nanom diamond particles embedded in an organic matrix (e.g. epoxy). Such nanom diamond particles are derived from the detonation of dynamite (e.g. TNR and RDX) in oxygen deficiency atmosphere. The nanom diamond particles are formed instantaneous from the residue carbon during the transient ultrahigh pressure and temperature. These nanom diamond particles are defect ridden and they are coated with a softer carbon coating (e.g. bucky balls and nano tubes). The softer carbon coating can lubricate the cutting edge in-situ during the action of nanom polishing. The nanom diamond has an intrinsic tight size distribution (4-10 nanoms) so the scratch of delicate semiconductor chip (e.g. IC with copper circuitry) is avoided. Moreover, the nanom diamond itself contains built-in defects that will allow nanom chipping so the abrasive can be self-sharpened for continual polishing with high efficiency. In addition, the nano radius of the nanom diamond can polish the wafer in the ductile domain so chipping of the polished surface is avoided. The result would be a clean and smooth surface with minimal mechanical degradation or thermal damage. The resinoid matrix that holds nanom diamond is impregnated with nanom metal particles (e.g. Ni) that can be dissolved by acidic slurry. Alternatively, the epoxy matrix may also incorporate nanom salt particles (e.g. NaCl) that can be dissolved in water. The dissolution of non-carbon nanom additives will expose new nanom diamond particles continually so the efficient polishing can be sustained.